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09/750,734	12/27/2000	Sanjay S. Natarajan	42390P10050	7194

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EXAMINER

GURLEY, LYNNE ANN

ART UNIT PAPER NUMBER

2812

DATE MAILED: 01/04/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/750,734

Applicant(s)

NATARAJAN ET AL.



Examiner

Lynne A. Gurley

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 21 November 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-7, 18, 20, 24, 26, 28 and 29 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-7, 18, 20, 24, 26, 28 and 29 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

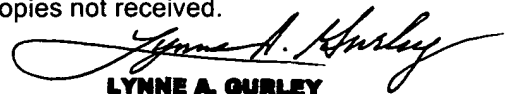
**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**LYNNE A. GURLEY****PRIMARY PATENT EXAMINER****TC 2800, AU 2812****Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

### **DETAILED ACTION**

This Office Action is in response to the amendment with remarks filed 11/21/05.

Currently, claims 1-7, 18, 20, 24, 26 and 28-29 are pending.

#### ***Response to Amendment***

1. Applicant's request for reconsideration of the finality of the rejection of the last Office action is persuasive and, therefore, the finality of that action is withdrawn.

#### ***Allowable Subject Matter***

2. The indicated allowability of claims 1-7, 18, 20, 24, 26, and 28-29 are withdrawn in view of the newly discovered reference(s) to Schinella et al. (US 6,350,700), Subramanian (US 6,127,089), Ryan (US 6,869,879), Pangrle et al. (US 6,383,950), and Cheung et al. (US 6,562,544). Rejections based on the newly cited reference(s) follow.

#### ***Claim Rejections - 35 USC § 112***

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 18 and 20 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

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In line 2, claim 18 contains the phrase “the dielectric layer”. It is suggested that this phrase be changed to “the dielectric cap layer” for proper antecedent basis. The same issue is in line 1 of claim 20.

### ***Specification***

1. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

### ***Claim Rejections - 35 USC § 102***

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1-2, 7, 18, 20, 24, and 26 are rejected under 35 U.S.C. 102(e) as being anticipated by Ryan (US 6,869,879, dated 3/22/05, filed 11/3/00).

Ryan shows the method as claimed in figures 19-28 and corresponding text, with etch stop 2530 (fig. 25), base layer 120, first and second cap layers 130 and 1980, ARC 1960 (ARC layer and layers 130 and 1980 suppress reflections (column 10, lines 30-67; columns 11-12).

***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

6. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

7. Claims 3-6 and 28-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ryan (US 6,869,879, dated 3/22/05, filed 11/3/00) in view of Braeckelmann et al. (US 6,475,925, dated 11/5/02, filed 4/10/00).

8. Ryan shows the method substantially as claimed in the preceding paragraphs.

Ryan lacks anticipation only in not teaching that 1) wherein introducing the dielectric cap layer comprises introducing a plurality of alternating material layers; 2) wherein introducing the dielectric cap layer comprises introducing silicon dioxide as an ultimate layer; 3) wherein introducing a plurality of alternating material layers comprises alternating silicon dioxide layers with at least one other material layers; 4) wherein the number of alternating silicon dioxide layers comprises at least six; 5) and, wherein the base layer is doped with phosphorus or boron to serve as a collector of metallic contaminants.

Braeckelmann teaches repetition of the capping layers for formation of a multilevel interconnect (figs. 5-6).

It would have been obvious to one of ordinary skill in the art to have had the dielectric cap layer comprise introducing a plurality of alternating material layers; to have had introducing the dielectric cap layer comprise introducing silicon dioxide as an ultimate layer; to have had introducing a plurality of alternating material layers comprise alternating silicon dioxide layers with at least one other material layers; to have had the number of alternating silicon dioxide layers comprises at least six; and, to have had the base layer is doped with phosphorus or boron to serve as a collector of metallic contaminants, in the method of Ryan, with the motivation that it is also conventional for the silicon oxide part of the capping layer to be over the ARC layer as the ultimate layer (Also, see Cheung et al., US 6,562,544 layer 240 over ARC layer 210) and with the motivation that Braeckelmann teaches that depending on the number of levels of interconnect, the number of alternating materials can increase and, with the motivation that the base layer is conventionally chosen to decrease the capacitance of, to increase the reliability of

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and to structurally support the interconnect, BPSG or PSG or BSG are all conventional alternatives to the layer 120.

9. Claims 1-7, 18, 20, 24, 26 and 28-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schinella et al. (US 6,350,700, dated 2/26/02, filed 6/28/00) in view of Subramanian et al. (US 6,127,089, dated 10/3/00, filed 8/28/98).

Schinella shows the method substantially as claimed in figures 1-12 and corresponding text, as: introducing an etch stop layer 16 over a substrate 2/102/10; introducing a base layer 20 over the etch stop layer; introducing a dielectric cap layer 26 (silicon dioxide; note that the cap layer is accompanied by layers 30 and 38 which are masking and ARC layers) over the base layer between an interconnection line 80 and a contact point 4/6 on the substrate, the cap layer being selectively etchable with respect to the etch stop layer; introducing a photoimageable material 40 over the dielectric cap layer; and patterning an interconnection 80 to the contact point, wherein the dielectric cap layer is configured to suppress substrate reflections during patterning (layer 38 accompanies cap layer 26 and is an ARC layer). Patterning an interconnection to the contact point comprises patterning an interconnection 80 directly to a device 4/6 on the substrate. The etch stop layer 16 is silicon nitride.

Schinella also shows the method as: forming a planarized base layer 20 over a substrate 2/102 having a plurality of devices 4/6; forming a dielectric cap layer 26 (silicon dioxide) over the base layer (note that the cap layer is accompanied by layers 30 and 38 which are masking and ARC layers, the layer 30 may have a thickness of 30-400 nm, which is more than five times thicker than the layer 26, which is 20-60 nm); patterning an interconnection 80 to a contact point,

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wherein the dielectric cap layer is configured to suppress substrate reflections during patterning (layer 38 accompanies cap layer 26 and is an ARC layer).

Schinella lacks anticipation only in not explicitly teaching that: 1) the cap layer comprises a plurality of different material layers, wherein each respective layer of the plurality of different layers is selectively etchable with respect to the etch stop layer; 2) the dielectric cap layer is formed by alternating a first material layer and a second material layer having a higher dielectric constant than the first material layer; 3) wherein introducing the dielectric cap layer comprises introducing a plurality of alternating material layers; 4) wherein introducing the dielectric cap layer comprises introducing silicon dioxide as an ultimate layer; 5) wherein introducing a plurality of alternating material layers comprises alternating silicon dioxide layers with at least one other material layers; 6) wherein the number of alternating silicon dioxide layers comprises at least six; 7) wherein the dielectric cap layer comprises a first dielectric layer, the method further comprising introducing a second dielectric layer between the first dielectric layer and the etch stop layer; 8) wherein the plurality of different material layers includes at least one layer of silicon oxynitride; 9) and, wherein the base layer is doped with phosphorus or boron to serve as a collector of metallic contaminants.

Subramanian teaches that conventionally, the cap layer (fig. 1A, 44; column 1, lines 51-67, column 2, lines 1-5) may comprise multiple layers which include silicon dioxide/TEOS, nitride and BARC layers (organic). The sequence may be a bottom TEOS layer, a middle nitride layer and a top BARC layer (organic). These layers are used in combination as masking layers to pattern the underlying dielectric layer.



It would have been obvious to one of ordinary skill in the art to have included the layers 30 (nitride middle layer) and 38 (top ARC layer) to be considered to be a part of, or an extension of the cap layer 26, in the method of Schinella, as taught in the method of Subramanian, with the motivation that Subramanian teaches that it is conventional to include these masking and ARC layers in the term “cap layer”. Therefore, it would have been obvious to one of ordinary skill in the art to have had the cap layer comprise a plurality of different material layers, wherein each respective layer of the plurality of different layers is selectively etchable with respect to the etch stop layer; and to have had the dielectric cap layer be formed by alternating a first material layer and a second material layer having a higher dielectric constant than the first material layer; and to have had introducing the dielectric cap layer comprise introducing a plurality of alternating material layers; and to have had introducing a plurality of alternating material layers comprise alternating silicon dioxide layers with at least one other material layers; and to have had the dielectric cap layer comprise a first dielectric layer, the method further comprising introducing a second dielectric layer between the first dielectric layer and the etch stop layer. (Also, see Pangrle, US 6,383,950, for support of the cap layer 112 or 204 being multiple layers with different functions and materials, i.e., ARC, barrier, passivation, and etch stop; column 1, lines 55-67; column 2, lines 1-5; column 4, lines 39-47).

It would have also been obvious to one of ordinary skill in the art to have had introducing the dielectric cap layer comprises introducing silicon dioxide as an ultimate layer; or, to have had the number of alternating silicon dioxide layers comprise at least six; or, to have had the plurality of different material layers include at least one layer of silicon oxynitride, in the method of Schinella, with the motivation that it is also conventional for the silicon oxide part of the capping

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layer to be over the ARC layer as the ultimate layer (Also, see Cheung et al., US 6,562,544 layer 240 over ARC layer 210) and with the motivation that depending on the number of levels of interconnect, the number of alternating materials can increase, and with the motivation that silicon oxynitride is an alternative to the nitride material used in layer 30 or 38 (also see Cheung col. 4, lines 53-55).

It would have also been obvious to one of ordinary skill in the art to have had the base layer be doped with phosphorus or boron to serve as a collector of metallic contaminants, in the method of Schinella, with the motivation that the base layer is conventionally chosen to decrease the capacitance of, to increase the reliability of and to structurally support the interconnect, BPSG or PSG or BSG are all conventional alternatives to the low k layer 20.

10. Claims 1-7, 18, 20, 24, 26 and 28-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Braeckelmann et al. (US 6,475,925, dated 11/5/02, filed 4/10/00) in view of Subramanian et al. (US 6,127,089, dated 10/3/00, filed 8/28/98).

Braeckelmann shows the method substantially as claimed in figures 1-6 and corresponding text, as: introducing an etch stop layer 202 over a substrate 110/106/100; introducing a base layer 204/206 over the etch stop layer; introducing a dielectric cap layer 208 (silicon dioxide; note that the cap layer is accompanied by layers 302 and 38 which is an ARC layer) over the base layer between an interconnection line 404/604 and a contact point 112 on the substrate, the cap layer being selectively etchable with respect to the etch stop layer; introducing a photoimageable material 304 over the dielectric cap layer; and patterning an interconnection 404/604 to the contact point, wherein the dielectric cap layer is configured to suppress substrate

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reflections during patterning (layer 302 accompanies cap layer 208 and is an ARC layer).

Patterning an interconnection to the contact point comprises patterning an interconnection 404/604 directly to a device 106 on the substrate. The etch stop layer 202 is silicon nitride.

Braeckelmann also shows the method as: forming a planarized base layer 204 over a substrate 110/106/100 having a plurality of devices 106; forming a dielectric cap layer 208 (silicon dioxide) over the base layer (note that the cap layer is accompanied by layer 302 which is an ARC layer, the layer 302 appears to be at least as thick, or thicker than the layer 208, which is less than 50 nm or preferably less than 20 nm); patterning an interconnection 404/604 to a contact point, wherein the dielectric cap layer is configured to suppress substrate reflections during patterning (layer 302 accompanies cap layer 208 and is an ARC layer). Figures 5-6 show the repetition of the layers in order to extend the interconnect. ARC 302 is made of silicon oxynitride.

Braeckelmann lacks anticipation only in not explicitly teaching that: 1) the cap layer comprises a plurality of different material layers, wherein each respective layer of the plurality of different layers is selectively etchable with respect to the etch stop layer; 2) the dielectric cap layer is formed by alternating a first material layer and a second material layer having a higher dielectric constant than the first material layer; 3) wherein introducing the dielectric cap layer comprises introducing a plurality of alternating material layers; 4) wherein introducing the dielectric cap layer comprises introducing silicon dioxide as an ultimate layer; 5) wherein introducing a plurality of alternating material layers comprises alternating silicon dioxide layers with at least one other material layers; 6) wherein the number of alternating silicon dioxide layers comprises at least six; 7) wherein the dielectric cap layer comprises a first dielectric layer,

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the method further comprising introducing a second dielectric layer between the first dielectric layer and the etch stop layer; 8) wherein the plurality of different material layers includes at least one layer of silicon oxynitride; 9) and, wherein the base layer is doped with phosphorus or boron to serve as a collector of metallic contaminants.

Subramanian teaches that conventionally, the cap layer (fig. 1A, 44; column 1, lines 51-67, column 2, lines 1-5) may comprise multiple layers which include silicon dioxide/TEOS, nitride and BARC layers (organic). The sequence may be a bottom TEOS layer, a middle nitride layer and a top BARC layer (organic). These layers are used in combination as masking layers to pattern the underlying dielectric layer.

It would have been obvious to one of ordinary skill in the art to have included the layer 302 (top ARC layer) to be considered to be a part of, or an extension of the cap layer 208, in the method of Braeckelmann, as taught in the method of Subramanian, with the motivation that Subramanian teaches that it is conventional to include ARC and masking layers in the term "cap layer". Therefore, it would have been obvious to one of ordinary skill in the art to have had the cap layer comprise a plurality of different material layers, wherein each respective layer of the plurality of different layers is selectively etchable with respect to the etch stop layer; and to have had the dielectric cap layer be formed by alternating a first material layer and a second material layer having a higher dielectric constant than the first material layer; and to have had introducing the dielectric cap layer comprise introducing a plurality of alternating material layers; and to have had introducing a plurality of alternating material layers comprise alternating silicon dioxide layers with at least one other material layers; and to have had the dielectric cap layer comprise a first dielectric layer, the method further comprising introducing a second dielectric

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layer between the first dielectric layer and the etch stop layer. (Also, see Pangrle, US 6,383,950, for support of the cap layer 112 or 204 being multiple layers with different functions and materials, i.e., ARC, barrier, passivation, and etch stop; column 1, lines 55-67; column 2, lines 1-5; column 4, lines 39-47).

It would have also been obvious to one of ordinary skill in the art to have had introducing the dielectric cap layer comprises introducing silicon dioxide as an ultimate layer; or, to have had the number of alternating silicon dioxide layers comprise at least six; or, to have had the plurality of different material layers include at least one layer of silicon oxynitride, in the method of Braeckelmann, with the motivation that it is also conventional for the silicon oxide part of the capping layer to be over the ARC layer as the ultimate layer (Also, see Cheung et al., US 6,562,544 layer 240 over ARC layer 210) and with the motivation that depending on the number of levels of interconnect, the number of alternating materials can increase, and with the motivation that silicon oxynitride is used as the ARC layer (also see Cheung col. 4, lines 53-55).

It would have also been obvious to one of ordinary skill in the art to have had the base layer be doped with phosphorus or boron to serve as a collector of metallic contaminants, in the method of Braeckelmann, with the motivation that the base layer is conventionally chosen to decrease the capacitance of, to increase the reliability of and to structurally support the interconnect, BPSG or PSG or BSG are all conventional alternatives to the low k layer 20.

*Conclusion*

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. See the PTO Form 892.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynne A. Gurley whose telephone number is 571-272-1670. The examiner can normally be reached on M-F 7:30-4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Lebentritt can be reached on 571-272-1873. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Lynne A. Gurley  
Primary Patent Examiner  
Art Unit 2812

LAG  
December 28, 2005